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THE ORGANIZATION OF SCIENTIFIC MEN

By J. McKEEN CATTELL

THE modern world is notable for the advance of science, of education, of democracy and of social organization. It may be assumed by a scientific man in a scientific journal that the advance of science is the most fundamental, for it has made the others possible. The entire development of our industrial civilization is due to the applications of science. Democracy has progressed because the productivity of labor has been so multiplied that one man can now do the work that once required four, because the length of life has been so increased that the years of work are doubled. Available wealth having increased four-fold, education and equality of opportunity for all have become practical ideals.

Trade guilds, of which universities were once examples, date to long passed centuries; the modern period has witnessed an elaborate organization of industrial and social groups. Legislatures are themselves such groups, representing mainly the holding classes. In order to obtain legislation for others, such as woman suffrage or the improvement of the conditions of labor, special organization is required. It is equally essential in commerce and in industry. Corporations and trade unions have largely replaced the competitive system among individuals and are integral parts of our social order. There is scarcely any group that has been so backward in democratic organization as men of science; there is no other in which the conditions make the right kind of organization more necessary.

In the slow movement toward democracy men of science have played a curious part. Their work has made democracy possible, although this is a result that as a group they have neither sought nor recognized. They have indeed often regarded it as ignoble to do useful or profitable work and have not accepted as equals those who did such work. Men of science have come from the privileged classes or have been dependent on them. They do not earn their livings by scientific research, but are usually amateurs, having either inherited wealth or doing other work for the support of their families. The most typical scientific man to-day is a university professor, meagerly supported by charity to tutor the children of the well-to-do, devoting his spare time to science from curiosity and emulation.

The satisfaction of curiosity is a fundamental instinct, the game of scientific discovery is one of the finest of sports, the appreciation or kindly envy of others is a pleasant tribute; but the rewards of science are queerly out of proportion to what science has accomplished for human welfare. Mr. Carnegie and Mr. Rockefeller may return some of the millions acquired through the applications of science; but science would be indefinitely richer if a cent were paid to it each time a match were struck or a pin used. Full payment would be three fourths of the wealth produced annually by the industrial nations. It might be admirable for scientific men to give what they can and to get only what they need, if they did so voluntarily; but they deserve about as much credit as the natives in an African protectorate. And they do not get what they need, for their fundamental want is to be in a position to advance science to the limit of their ability.

The two most important services to society are the bearing and rearing of children and scientific research. Their performance has been dependent on fundamental instincts which organized society has done more to thwart than to strengthen. It is essential for the welfare of all that these services shall be rendered. It seems unlikely that women will permanently accept the promise of bliss in heaven as a reward for pain on earth, or that scientific men will regard a title or a degree, a medal or membership in an academy, as fit payment for their work.

Competitive social organization enables a man to sell his services to those who will buy them; it makes no provision for services to society. When physicians limit the spread of disease by learning its causes they are not paid, but on the contrary lose the fees of patients. When lawyers avoid litigation, their reward is the lack of retainers. Should newspapers seek to prevent war they would limit their circulation. And so it is in all directions.

Art, like science of universal value, is in a better economic condition, for its products can be sold. Joy in work should be the right of every worker; it may be the greatest in the creative work of art and of science; but it does not give exemption from the ordinary needs of life; it can scarcely exist if the worker has not the means and the time to do his work in the best way. Printing and engraving, methods of automatically reproducing acting and music, are scientific inventions which have made art both democratic and self-supporting. It is also the case that the state pays for works of art for the use of all. The people and the state must learn to pay for the products of scientific research.

The situation for science is slowly improving, but through the working of economic forces, rather than through the efforts of scientific men. Students in medical, engineering and scientific courses must be trained by professors competent in science, and the university recognizes the advancement of science and scholarship as one of its functions. Foundations are endowed expressly for scientific research. Commercial firms need chemists, physicists and biologists in their business, and patent laws make some kinds of research profitable. The government has learned that it pays to employ scientific men for practical results, and that in some directions new investigations must be made. It is recognized that research not obviously and immediately useful is necessary, although no satisfactory method has been devised to defray its cost.

Society, controlled by privilege and precedent, has been parasitic on inborn instincts and inbred sentiments for its scientific research. The instincts and sentiments are in large measure inherited from the feudal and aristocratic period and will gradually atrophy, for the reactions only occur in answer to adequate stimuli. A complete revolution is demanded by modern democracy. The promotion of science being for the benefit of all is a function of the state and of a world organization. If a group of nations may make the maximum military establishment of a given nation a hundred thousand soldiers, it can perform a more useful function by making the minimum scientific establishment a hundred thousand men engaged in research. A decent regard for the opinions of mankind should lead each nation to support one research institution of the same cost as each of its battleships. The benefits of scientific research are greatest for the nation conducting it; but they accrue to the whole world, and each nation should contribute in proportion to its consumption.

Applied science has accomplished much by providing food, clothing and shelter for nearly all, bath-tubs, telephones and automobiles for many. But so long as

> A man's work lasts from sun to sun,
> A woman's work is never done,

so long as children work to their hurt and are denied the chance to prove what they can best do, the production of wealth must be further increased by scientific research and invention. By medicine, hygiene and better living conditions, infant mortality in some places has been reduced from one half to one tenth; cholera, smallpox, yellow fever and the plague have in large measure, tuberculosis, typhoid and other diseases have to some extent been controlled. But so long as ten million children die needlessly every year, so long as an epidemic of influenza may kill five million people, the need for research and its applications is more urgent than any other need.

Science has concerned itself mainly with the control of the physical world: the science of human conduct and of its control is only beginning. We have been more successful in the production of wealth than in its distribution and use. Our churches, schools, law courts, governments and other institutions are in large measure survivals from a pre-scientific and a pre-democratic era. But little has been done to investigate the relation of the individual to his surroundings and to make the most desirable adjustment, still less to obtain the best kind of individuals. The contribution of the psychological sciences to the production of wealth should equal that of the material sciences; their total contribution to human welfare should be greater. For science has not only supplied the economic basis for our civilization; it has not only made economic slavery wanton and intolerable; it has freed us from superstition and unreason; it is in itself the most perfect art and the best religion, the force not ourselves that makes for truth and righteousness.

"The harvest truly is plenteous, but the laborers are few." And this is in large measure because we limit ourselves to the solution of St. Matthew: "Pray ye therefore the Lord of the harvest, that he will send forth laborers into his harvest." We scientific men like "the conies are but a feeble folk"; but unlike them we do not make our "houses in the rocks"; rather as sheep we follow the shepherd to the shearing. We work for the lords of the harvest and depend on them to care for us. We have not awakened from the old dreams; we do not see the new world in which the workers of the world are learning to direct its work. What was printed many years ago is surely forgotten, so a reference[1] to the situation may be quoted as the writer saw it then, as he sees it now:

> Evolution has progressed by the survival of the strong and the cunning, of those armed with tooth and claw, of those quick to run and ready to hide. It has given us the vulture and the parasite. Human history has left us the legacy of the iron hand and the crooked back. The man engaged in scientific work has too often filled the position of an upper servant—a tutor to the sons of the rich, a priest subscribing to tenets that are outworn, an employee dependent on the favor of presidents and boards,—for whom silence is silver and flattery gold. As the downtrodden have submitted to servitude on the ground that they will have their reward in a future life, so scientific men have labored in the hope of recognition and posthumous fame. They have scrambled for degrees, titles, membership in academies and the like, trying to climb upon each others' necks. But the things that have been are not the things that shall be. The men who labor with their hands have learned to unite in trade unions; they have shown themselves ready and able to make the utmost sacrifices for their common cause. And they have won; they have used the governors of states and the president of the United States for their purposes. Their leader can speak to the president on terms of equality; the

[1] Address of the president of the American Society of Naturalists. *Science,* April 10, 1903.

> members of the National Academy of Sciences waited last spring for an hour in the anteroom of the White House until he did them the honor to shake hands with them. Is there a university in the world whose faculty would resign because one member was unjustly treated, or would scientific men subscribe ten per cent. of their incomes to support a faculty that had so resigned? But the things that have been are not the things that shall always be.

Year after year has passed since this was written. The head of the American Federation of Labor still dictates to the president of the United States; scientific men still wait hat in hand on the almoners of Mr. Carnegie and Mr. Rockefeller. University professors even yet find silence to be silver, flattery to be gold. Now as then the National Academy of Sciences plays the part of an exclusive social club for those who have arrived. Royal Societies and Imperial Academies were fine embodiments of the spirit of a past period. The universities had fallen into dogmatic routine and external control; scientific men made notable progress by the organization of academies which they themselves conducted. Scientific invention was then youthful and vigorous; it was stimulating for the amateurs of a city to meet in a club to discuss their discoveries, usually trivial, but at times of fundamental importance.

But we no longer live in the seventeenth or the eighteenth century, even though their dead hands still lie heavy upon us. Science begot industrial civilization and must now dwell in the house of the giant that is its offspring. The noble and his serfs, the squire and his peasants, have been replaced by the capitalist and the proletariat. Kings yielded to parliaments, the barons to the commons. Now we have an unstable combination of indirect democracy and temporary dictators, while corporations and trade unions are becoming the real forces of government. The Bible has in large measure been supplanted by the newspapers, the church by the movies. Mr. Edison rather than Lord Rayleigh is the scientific representative of the industrial world. The park-like civilization of aristocracy with its hidden peasant hovels is being razed for the creation of cities and factories. The etiquette of the gentleman is yielding to the rough ways of democracy.

The adjustment of scientific men and their organizations to modern democracy has been slow and partial. The land that is the "mother of parliaments" was responsible for the organization of the first special scientific societies. The Linnean Society for the promotion of zoology and botany was founded in 1788; the Royal Astronomical Society in 1820; the Zoological Society in 1826; the Chemical Society in 1841. In Germany, under the leadership of Humboldt, the first national association for the advancement of science was established in 1828; the British Association followed in 1831. There are now special scientific societies for different sciences and national associations for the advancement of science in all the greater countries.

The American Association for the Advancement of Science held its first meeting in 1848, being the continuation of the Association of American Geologists and Naturalists, founded in 1840. The American Chemical Society was organized in 1876; the American Society of Naturalists in 1883; the American (then the New York) Mathematical Society and the Geological Society of America in 1888. The national associations for medicine, engineering and education were organized at a comparatively early period. There are now more than fifty national societies in the United States devoted to the different branches of science.

The principal objects of these organizations have been to hold meetings for the presentation of scientific papers and in some instances to conduct journals. But they also perform to a certain extent the functions of guilds or trade unions, and this is more especially true of the societies concerned with engineering, medicine and teaching. The American Association of University Professors, organized in 1915, had such functions primarily in view, although it has been timid about the question of salaries and privileges. A union of scientific employees of the government and unions of academic teachers, affiliated with the American Federation of Labor, have recently been formed.

The American Association for the Advancement of Science has made notable progress beyond the similar associations of other nations by the support of a weekly official journal and by affiliation with the national societies devoted to the different sciences. It may be regarded as an association of these societies; they are represented by delegates on its council and have charge of the scientific programs when they meet with it. The sixteen sections of the association cover completely the pure and applied sciences, including the psychological, humanistic and political sciences. Committees of these sections are formed of representatives of the association and of the affiliated societies. The council of the association and the sectional committees are thus organized on a democratic basis to represent through the association and through the national scientific societies the scientific men of the country.

All those professionally engaged in scientific work are eligible to fellowship in the association and all those interested in the advancement of science to membership. The members number about 12,000; there are funds for research amounting to over $100,000; the annual dues are only five dollars. In England it costs fifteen dollars to be a member of the British Association and to receive the national weekly scientific journal.

The American Association has accomplished important work through its council, through its executive committee, through its sectional committees and through numerous special committees, including the committee of one hundred on public health and the committee of one hundred on scientific research. The latter committee, organized in 1914, arranged subcommittees on research in each of the sciences, on grants for scientific research, on research in educational institutions, on research under the government, on research under states and municipalities, on research in industrial establishments and in other directions. In order, however, that the association may represent and forward the interests of science and of scientific men, a more general concern for its work is essential. Scientific men are intellectually too individualistic and socially too submissive to unite with the loyalty which characterizes the trade unions. But the future belongs to the national scientific societies and to the association of scientific workers in which they are combined.

In addition to a house of commons, we still have a house of lords. The National Academy of Sciences was chartered by the Congress in the emergency of the civil war, and was made by law the adviser of the Government on scientific questions, with the stipulation that no member should receive payment for his services. It was originally limited to 50 members elected for distinction in science; the members now number about 200. The academy administers funds for research and medals amounting to over $200,000.

For some fifty years the academy enjoyed a peaceful and pleasant existence. Membership was an honor appreciated by the elect, and the social features of the meetings were agreeable to the privileged. At that time the eighteenth amendment had not been even threatened, and certainly no one ever dreamed of the application of the nineteenth amendment to the academy. The duty of listening to papers on the scientific program was not onerous, for while they were often unintelligible they were not numerous. At one meeting Benjamin Peirce, after writing, correcting and erasing equations on a blackboard for an hour, remarked that he was sorry that the only member who could understand them was in South America. The election of new members was the great event of the meeting. No other business transacted was perhaps more significant than a resolution to endorse the metric system, which was voted in the negative.

The academy has been called on by the Government to render only a few reports. Perhaps the most typical of these was to determine whether the ink with which the Declaration of Independence was written can be prevented from fading; for it was not, of course, a question of preserving the sentiments of that document. It may also be significant that the academy holds its annual meetings in a museum and is presided over by our most eminent student of invertebrate fossils. It is said that a representative once asked in the House "What does the National Academy of Sciences do?" and the reply was: "The members write obituaries of each other when they die, and it is a pity they have so little to do."

The advice of the academy has not been sought by the government because it has developed its own departments, employing hundreds of scientific men, and the heads of the bureaus are not usually members of the academy. Advice given without responsibility and free of charge is usually worth about what it costs. When thirteen years ago the academicians made their quadrennial visit to the White House to wait upon President Taft and, following various delegations of men, women and children, passed before him, he recognized Dr. Weir Mitchell and said: "Why, Mitchell, what on earth are you doing in this crowd?" Dr. Mitchell explained with much dignity what an honorable body it was, being by law the scientific adviser of the government; but it may be doubted whether President Taft subsequently remembered the academy's existence.

President Wilson, an eighteenth century academician cast on the rough waters of the democratic politics of to-day, had appreciative sympathy for the National Academy. Shortly after his inauguration, the American Association appointed a committee to urge the selection of a scientific man for chief of the Weather Bureau, and the committee proposed to the president that he ask the advice of the academy in accordance with the provisions of the law. This he did and appointed one of the three scientific men named by the academy. He also appointed as chief of the Bureau of Fisheries the scientific man recommended by the American Society of Zoologists. Such methods are useful so long as scientific offices are in danger of being used as part of the spoils of office; but the appointment and promotion of scientific men in the government service should be through the choice of their associates, rather than on the recommendation of an outside body.

The recent revival of the National Academy has, however, not come from the modest recognition given to it by President Wilson, but is an adaptive response to modern conditions. Similar movements have occurred in the churches, in the universities and in other inherited institutions. When in the course of evolution, God let the dry land appear and saw that it was good, the creatures of the swamps suffered diverse fates. Most of them became extinct, some survived in their shells, a few developed into the higher animals of to-day. Like the churches, the universities and the rest, the National Academy of Sciences lies at present on the knees of the Gods, and only omniscience knows its fate. It may be an eddy in the stream; it may be a stepping stone.

A proximate cause of the reanimation of the academy was the enterprise of a distinguished man of science, elected to membership at a comparatively early age, as is the fortune of astronomers—for most astronomers are born to greatness through the circumstance that the superiority of their intellect is enhanced by their costly instruments and by the inaccessibility and sublimity of the starry firmament. This able and ingenious entrepreneur in science stirred several academicians by the contagion of his enthusiasm and took the academy in hand. Lectures have been endowed for the meetings; proceedings have been established where by resolution of the academy members are instructed to bury the cream of their researches; within a single year the ex-president of the nation and the ambassador of that empire on whose commerce the sun never sets made addresses at the dinners; an earl and a prince were present. The Carnegie Corporation has undertaken to erect for the academy its marble mausoleum.

A national academy, however, is wrapped in the inertia of its great traditions and bears the Atlantean load of a crystallized earth. Most ingeniously, a National Research Council has been established as a committee of the academy. This morganatic spouse can wear the royal jewels and yet associate with ordinary scientists, engineers and the like. She can be fertile without limit in committees, as their nourishment may be entrusted to charity. For this reason she can also adopt all the children on which she can lay her hands; indeed she may entice or kidnap certain gilded youths who will add to the family wealth. She has spread her net over the oceans and has set her traps for international fish, excluding those held to be unclean.

Even the humble children of the present writer have not escaped the telescope of this mother of enterprises. While his legal offspring may stay at home, some of those of which he was only one of many guardians have been abducted. Thus all the sub-committees of the committee of one hundred on scientific research of the American Association were bodily conveyed to itself by the Research Council, and the sectional committees of the association, representing the national societies, have been duplicated by the council. The committees of the council were originally nominated in equal share by the American Association, the National Academy and the Special National Societies; the writer urged that they should be equally responsible to those bodies. But cooperation prevailed, and when the lion and the lamb lay down together the lamb was inside the lion. The Research Council also proposed cooperation with the American Association as a whole. It offered to provide a permanent secretary for the association, to rent an office to the association in the attic of its building, and to let the association attend to the popularization of science while the council cared for research. Whether the Research Council belongs to the National Academy, or the National Academy belongs to the Research Council, or both are satellites of Pasadena, is a problem of three bodies that is difficult of solution. The American Association still belongs to its twelve thousand members, even though they have not learned to use their heritage.

The Carnegie Corporation, the Rockefeller Foundation and the National Research Council are another problem of three bodies. The Research Council depends on the endowed establishments for support, but the chairman of the Research Council became president of the Carnegie Corporation and its secretary has became a trustee of the Rockefeller Foundation. Scientific research certainly needs all the money it can get; it is in the interest of the nation that it get all the money that it needs. *Pecunia non olet.* A clergyman once told his congregation that it was well when the righteous gave to the Lord, but it was still more blessed when the money was obtained from the wicked, for then it was all gain. If we are taxed for the use of steel and petroleum, it is not amiss that a fraction of the proceeds should be returned to us for science and education. But after all the people can tax the preemptors of steel and petroleum, and it may in the long run be safer and even more profitable for men of science to be free from the charity and control of the classes of privilege and sell their services to the people for what they are worth.

One of those high in office in the National Research Council began an address:

> A general of the regular army listening to a description of the National Research Council remarked, "You are the General Staff of the Army of American men of science."

Mr. Elihu Root, trustee of many institutions and attorney for many corporations, says in a paper written for the council and widely distributed by it:

> The effective power of a great number of scientific men may be increased by organization, just as the effective power of a great number of laborers may be increased by military discipline.

It may be that the officers of the National Research Council are prepared to command the privates of science and that some employers would like to increase the effective power of laborers by military discipline. But what do the laborers and the scientific men think about it?

Frivolity may be unbecoming in the sanctuary of the higher organization of science; but the individual organism can exhibit only those defensive reactions which are its natural response to the situation. The Rockefeller-Carnegie Research Council (the R_2C_2) is prepared to direct scientific research and has good intentions for every day on the calendar. But there you are. Dr. John C. Branner, in his admirable book of negro stories printed just before his death, tells us that long ago he visited one of the former slaves of his father's plantation and asked her: "Don't you think you were better off as a slave?" And this is what Aunt Ellen replied:

> De Lawd bless yo' soul, chile, dat's a fac'; hit's jes lak you ben a sayin'. I knows I had mo' to eat an' mo' to wear, an' a better house to live in, an' all o' dem things, an' you all was mighty good to me; an' I didn' have none o' dese here doctah's bills to pay. But Law', honey, atter all, dah's de feelin's.

Unlike the worldly-wise steward in the parable, the scientific man can dig and to beg he is not ashamed. He digs for others and then begs for a bit of the gold that he has dug. But why should he not keep for himself and for his work part of the treasure that he discovers? The applications of electricity due to research work in the laboratory add billions of dollars a year to the wealth of the world. Why can not scientific men learn how to retain even one per cent. of such wealth, which when reinvested in research would again yield high usury to science and to society? It is a long way, but the world does rise slowly in spiral course to higher levels. The prime mover is scientific research and its applications. Without the commerce and the industry created by science, there could be only a hereditary aristocracy of privilege and wealth controlling slaves. We have now reached the stage where we can at least foresee economic freedom for all. People must be fed and sheltered before they can be happy and free; they must be happy and free before they can be good and wise. Economic liberty must precede intellectual liberty. Science and its applications should be the chief concern of a democratic nation that would preserve its democracy and advance the freedom and the welfare of its people.